HOUSEFLY CONTROL WITH DRY BAITS FORMULATED FROM ORGANIC PHOSPHORUS INSECTICIDES AND SUGAR

by

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B. S., South Dakota State College
of Agriculture and Mechanic Arts, 1950

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Entomology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1955

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INTRODUCTION

Poisoned baits for chemical control of houseflies, Musca domestica L., are not entirely new. Milk and formalin baits were in widespread use from the turn of the century until about the beginning of World War II. In 1911, Smith reported successful fly control in a North Carolina dairy using milk and formalin set out in tin pans. He reported finding a pint of flies on the floor of a milk cooling room after a single night's baiting. Morril (1914) reported similar results with milk and formalin or arsenic. He also reported finding such attractants as beer, whey, sour milk, and dried blood fertilizer. Howard (1925) recommended using the bait in a "fountain" made from a water glass and a saucer. The milk-formalin mixture was poured into a water glass and then a saucer lined with a square of blotting paper was inverted over the mouth of the glass. The whole unit was then inverted and placed wherever flies congregated; as the fluid was consumed or evaporated it was replenished by the liquid in the glass. Another bait was made from sodium arsenite, brown sugar or molasses, and water. This bait was used in pans or "fountains"; it was also recommended for use as a surface treatment for manure piles. Felt (1917) advised spraying this mixture on bunches of straw and hanging them from the rafters of barns and houses, a forerunner of today's insecticide treated cords or strips.

Other control methods were also widely used, which included sanitation, pyrethrum sprays, screening, larviciding, and many others. Formalin and arsenic baits were also widely used but they were at times inconvenient to use. If pans went unattended, they soon dried and became useless. Pans, saucers, and containers sitting about were in constant danger of being upset and the contents scattered. Thirsty pets or children might have drunk some of the fluid with disastrous results.

By the end of World War II, DDT was in ample supply and was put into widespread use in controlling houseflies. Residual spraying of buildings with DDT for housefly control was common procedure and was so successful that at times even sanitation practices were by-passed when DDT could be substituted. The idea of baiting for fly control soon fell into disuse. After a year or two it became apparent that flies were able to develop resistance or tolerance to DDT, as well as other chlorinated insecticides. By the end of 1953, DDT, lindane, chlordane, and other chlorinated insecticides were ineffective as chemical controls for houseflies in places where they had been used previously, which comprised many parts of the United States. Since houseflies were showing a rapid increase in resistance, research was intensified to find new chemicals and methods of control. Organic phosphorus insecticides were found to be effective controls, but they were also much too toxic to be used in the unsuppressed manner that DDT

had been used. Since organic phosphorus insecticides were good stomach poisons as well as contact poisons it was thought that they might be used as baits. Very low concentrations of insecticide with an attractant could be safely used without undue danger to handlers and farm animals.

REVIEW OF LITERATURE ON ORGANIC PHOSPHORUS BAITS

During the fly season of 1952, Thompson et al. (1953) developed a method of controlling houseflies with a liquid bait made of 0.06 per cent tetraethylpyrophosphate (TEPP), 0.15 per cent lindane, and four to eight ounces of molasses or syrup. This bait was sprinkled on floors with a garden sprinkling can and sometimes on burlap sacks which were hung on rafters. The TEPP killed large numbers of flies in a short time, but the TEPP hydrolyzed in a short time and became ineffective; so the lindane was added to lengthen the effectiveness of the bait. Gahan et al. (1953) found that 0.05 per cent TEPP and 3 per cent blackstrap molasses was effective against flies in dairies in central Florida. They also found that lindane did not increase the effectiveness of the bait.

In 1952, Bruce (1953) developed a hardened or varnish bait using a di-alkyl phosphate known as Bayer L13/59, subsequently called Dipterex. One and one half grams of technical Bayer L13/59 was dissolved in sixteen ounces of Karo syrup which was painted on door frames, studdings, walls, window

frames, and window panes. It was reported that varnish baits gave good control for as long as two months after application.

Gahan et al. (1954) demonstrated that malathion, diazinon, and Bayer L13/59 were all superior to TEPP as toxicants in housefly baits; none of these compounds hydrolyze rapidly so they remain effective for a longer period of time. They also found that houseflies fed more readily on residues left by a dried syrup bait than on liquids. Laboratory tests further proved that houseflies fed more readily on granulated sugar than on sugar water. This proved to be a definite advantage, eliminating the necessity of keeping baits moist. This would make it especially advantageous in drier portions of the country. Dry baits could also be spread on absorptive surfaces and remain available to flies, and could also be spread thin enough for flies to pick it up readily but not be too easily picked up by farm animals. It also eliminated the necessity of messy containers to be upset or constantly in the way.

MATERIALS AND METHODS

Fly control on the Kansas State College campus has been the responsibility of the Department of Entomology during the 1953 and 1954 seasons. Previous to this time, certain departments had sprayed their livestock for general livestock pest control. The work was conducted in 1953 by a graduate student,

Virgil Bayles, who did routine residual spraying, distributed spray materials to dining halls and dormitories, and recommended sanitation practices where they were needed. The various departments were then assessed according to the amount of time and material it took to service each department. As flies became more and more resistant to chlorinated insecticides, by the middle of the 1953 fly season it was necessary to use other control methods. Pyrethrum was used toward the latter part of the 1953 fly season, but this proved to be very costly because there was relatively little residual action in pyrethrum and it was too costly to use continuously on a large scale.

Shortly before the 1954 fly season, at a meeting of departments concerned, it was mentioned that with previous methods it was too much of a burden on the budgets of larger departments such as Animal Husbandry and Dairy Husbandry. Dr. Herbert Knutson, Head of the Department of Entomology mentioned a letter from Dr. R. C. Bushland, Director of the Entomological Research Branch Laboratories of the Department of Agriculture at Kerrville, Texas. Dr. Bushland had inquired whether a cooperative experimental fly baiting program could be conducted at Kansas State College. Dr. Knutson suggested that perhaps such a program might be tried as a part of the regular campus fly control program. He pointed out that it would lower the cost of the program and at thesame time first hand observations on a relatively new technique in housefly

control could be made. It was agreed that the Department of Entomology would operate the baiting experiment as a part of the fly control program.

Early in June of 1954, Dr. H. M. Brundrett of the Entomological Research Branch Laboratories at Kerrville, Texas, arrived at Kansas State College to start the baiting studies. Early June rains delayed the actual start of the baiting, and the accompanying cool weather held the housefly populations fairly low. This cool wet period gave Dr. Brundrett and the writer, both of whom were unfamiliar with the campus, ample time to become acquainted with the buildings and the workers about the campus. There was also ample time to question herdsmen and foremen about feeding and handling routines for the farm animals in the various buildings. This prevented the possibility of putting bait in an area where animals were fed or feed was stored. Any places where animals were handled often were noted; as it developed later, one shed was not dry-baited simply because hogs were sorted and weighed in an alleyway. At no time were any pens of any kind baited that were occupied by animals, or likely to be on short notice. It was also necessary to know approximately when floors might be swept off or hosed down in order for the bait not to be swept up or washed away an hour or two after it had been applied. For example, the dairy barn milking room could not be baited at all because the floors were hosed down twice daily and the floor remained wet throughout most of the day.

The toxic ingredients in the various baits were (1) malathion, O,O-dimethyl-S-(1,2 dicarboxethyl)dithiophosphate; (2) diazinon, O,O-diethyl-O-(2-isopropyl-6-methyl-4-pyrimidinyl)thiophosphate; (3) chlorthion, O-(3-chloro-4-nitrophenyl)-O,O-dimethyl thiophosphate; and (4) Bayer L13/59 or Dipterex, O,O-dimethyl 2,2,2 trichloro-1-hydroxyethyl phosphonate. All the baits were used as dry baits except in one building where it was used as varnish bait like that used by Bruce, and all the baits were used at one per cent strength. In one instance it appeared necessary to change one of the baits, (chlorthion) to slightly higher percentage. Instead of changing the percentages it was decided to discontinue its use.

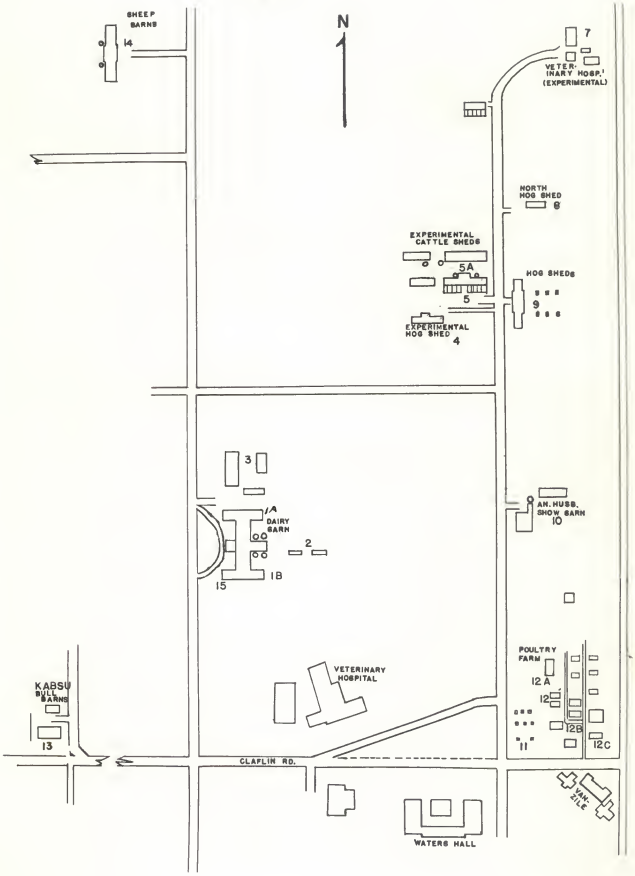
The buildings in which the tests were conducted were located to the north of the campus. The buildings were the animal housing units of the Animal Husbandry, Poultry Husbandry, Dairy Husbandry, Veterinary Medicine, and other departments which keep livestock. The buildings were more or less typical of farm buildings that could be found on farms in the midwest. All the buildings had hard surfaced floors except one which had a floor that was not cement or wooden. None of the buildings were screened to exclude entrance of flies. A description of the stations follows, together with the bait used; Plate I gives the location:

Station 1, an experimental calf barn which is the northeast wing of the dairy barn. Here baby calves were kept and

EXPLANATION OF PLATE I

The map on Plate I shows the buildings on the north part of the campus at Kansas State College which were used in the baiting studies. The numbers at the various buildings show the station numbers which were assigned to them.

PLATE I


SHEEP BARNS
14
N
7
VETERINARY HOSP.
(EXPERIMENTAL)
NORTH HOG SHED
8
EXPERIMENTAL CATTLE SHEDS
5A
5
HOG SHEDS
9
EXPERIMENTAL HOG SHED
4
3
1A
DAIRY BARN
2
1C
1B
15
AN. HUSB. SHOW BARN
10
POULTRY FARM
12A
12
12B
11
12C
VETERINARY HOSPITAL
KABSU BULL BARNS
13
CLAFLIN RD.
WATERS HALL

fed in individual pens until they were weaned. This wing did not have a concrete floor but it had one of hard packed clay. This wing was dry, clean, and airy. Malathion dry bait was used.

Station 2B, an experimental cow shed which is the southeast wing of the dairy barn. Here experimental dairy cows were housed. The sanitation was good but the floor was hosed periodically and floor was wet part of the time. Malathion dry bait was used.

Station 2, dairy bull sheds located east of the main dairy barn where herd bulls were housed. Malathion dry bait was used; later it was dropped because of a lack of flies.

Station 3, dairy barn hay sheds in which hay was stored and fed. One building was baited for about a week and then used as an untreated check. Malathion dry bait was used for that week.

Station 4, an experimental hogshed in which pigs were kept under controlled conditions on pig nutrition experiments. The floor was wet most of the time and fermenting manure attracted many flies. Water also dissolved the bait making it ineffective. Diazinon dry bait and later Bayer L13/59 dry bait used.

Stations 5 and 5A, experimental sheds for Animal Husbandry's principle experiments on feeding beef cattle were

in this series of buildings. They consisted of a series of open sheds and pens. These pens were attractive to large numbers of flies because molasses feeds were used; large amounts of manure produced by concentrated herds of cattle resulted in large numbers of flies. These buildings were used as untreated controls.

Station 6, two separate bull sheds a short distance from station 5, in which three beef bulls were housed. These sheds were used for an untreated control for a short time and dropped for lack of flies.

Station 7, the veterinary experimental hospital where animal disease studies are conducted. Several sheds are housing for experimental animals in cages and pens. The largest building was open and airy but the floor was mostly wet. One hog shed was cleaned regularly but had a very attractive odor to flies. Bayer L13/59 dry bait was used.

Station 8, the north hogshed in which a few hogs, apparently brood sows, were kept. Not heavily populated by animals so it was very dry and not especially attractive to flies. Used as an untreated control.

Station 9, the hog shed in which the main part of the swine herd was housed. This shed was nearly empty throughout the summer so flies did not congregate heavily in this building. The hog shed could not be dry baited so diazinon hard bait was used.

Station 10, the animal husbandry show barn commonly known as the "old stone barn" is used to house show stock. Manure was hauled regularly but nurse cows were stripped out onto the floor when show calves were through sucking; the milk attracted a number of flies. Chlorthion dry bait was used and later Bayer L13/59 was substituted.

Stations 11, 12, 12A, 12B, 12C, are all located on the poultry farm. Station 11 is a series of movable brooder houses located to the west of the permanent structures. Nothing was done with these; the brooder houses were kept as an extra check. Station 12, two large platforms or roosts upon which turkeys were reared to sufficient size to be put on range. A deep accumulation of droppings made a productive larval medium as well as an attractant to adult flies. Station 12A is a large laying house with large alleyways between banks of cages. Station 12B, two large houses in which chicks were reared to fryer size. Station 12C was a series of buildings in which eggs were handled, crates stored, and maintenance work on equipment was done. Inside the buildings sanitation was good but under the turkey roosts it was poor. Malathion dry bait was used in all the buildings at the poultry plant. For the turkey roosts malathion dry bait was tried; later malathion spray bait was substituted.

Station 13, K.A.B.S.U. bull barns and laboratories for the Kansas Artificial Breeders' Service Unit, located about

three quarters of a mile west of the campus. Treating was done only in the barns; nothing could be used in the laboratory. Here cleanliness was excellent; Bayer L13/59 was used.

Station 14, the sheep barns are two rather large open barns which house the sheep flock. Only one barn could be baited the other lacked concrete alleyways upon which bait could be spread. Bayer L13/59 was used.

Station 15, the southwest wing of the dairy barn is used to house newly weaned baby calves. Sanitation was good except in one corner where the floor was quite damp. Here occasional pens could be baited if they were empty; the herdsman was cautioned to clean the pen well before it was occupied. Chlorthion was used followed by malathion dry bait.

When Dr. Brundrett came to Manhattan, he brought with him a supply of ready mixed baits; however, as these baits were exhausted it was necessary to mix more bait. Insecticides were used from the Entomology Department's supply and mixed with granulated sugar purchased at a local grocery. The malathion, diazinon, and chlorthion baits were mixed from twenty-five per cent wettable powders. One pound of each of the above wettable powders was thoroughly mixed with twenty-four pounds of granulated sugar to give twenty-five pounds of one per cent active ingredient housefly bait, or simply, a one per cent bait.

The mixing operation was accomplished by means of a fiberboard insecticide drum with a clamp-on lid. The necessary ingredients were dumped in the drum, the lid clamped on and the drum rolled back and forth over the floor of the storeroom. At first it was noted that the wettable powders had a tendency to clump instead of breaking up and coating the individual sugar granules. Realizing the small percentage of insecticide in the mixture it became apparent that these clumps had to be broken. The wettable powder was then blended in a mortar with a pound or two of sugar, then the blended mixture was tumbled in the drum with the remaining sugar to make a bait of the correct strength. This blending method, though effective, proved to be laborious when working with large amounts at one time. It was found that wettable powder would break up well if run through a seive with a small amount of sugar; then it was possible to mix it in the drum in the usual manner.

When formulating bait from technical Bayer L13/59, it was necessary to grind it in a mortar, since it was in the form of fine white crystals. Ninety-one and one quarter gram of technical Bayer L13/59 were placed in a cast iron mortar with a tablespoon or two of sugar and ground with the pestle until the sugar and the Bayer L13/59 were both nearly as fine as confectioner's sugar. This mixture was then slowly added to 20 pounds of granulated sugar and mixed in a fiberboard drum in the same manner as the other baits.

The bait was scattered from shaker jars onto floors and other horizontal surfaces in the test buildings. These shaker jars were made from fruit jars with holes pierced through the lids. In order to make accurate applications, the jars were marked off in two ounce graduations. One major advantage used in this study was that the whole procedure of baiting and bait mixing were simple, inexpensive, time saving, and could be done with a minimum investment in equipment. In the future, it is firmly believed that dry baiting will become popular for these four reasons.

In order to estimate the effectiveness of baiting, it was necessary to use some uniform method of estimating the density of the fly population in any given building. Rather than use the Scudder Grid method, a technique was employed by counting the flies in an estimated square yard of floor or wall area. Four to ten counts were made in each building depending on the size of the building, and recorded in a field notebook. These counts were averaged and recorded in a permanent record along with the amount of bait needed, based upon the apparent results obtained from the previous applications. Counts were not made in the same area each time, because flies tended to congregate in different parts of a building at different times of the day. Counts were always made in areas of maximum density. Although the relative numbers of dead flies were noted, no counts of the dead flies were made; the best measurement of efficiency must be evaluated on the basis of the numbers of living flies present.

Baiting was started on June 21. Bait was applied about daily from that date for about two weeks. This was the period necessary to bring the fly population down to a point where daily applications were wasteful. The frequency of application was then changed from daily applications to two to four times a week. Bait was spread on floors and other horizontal surfaces in buildings, out of reach of livestock. No pens were baited unless they were unoccupied and would be for some time. This precaution may have seemed unnecessary because of the relatively low toxicity of the poison, but valuable breeding and experimental livestock were often involved. The toxicants, especially the chronic effects, were not known at that time and in some cases still need to be determined. The only casualties were some cats which had evidently licked enough bait from their feet to be fatal.

DISCUSSION AND RESULTS

Plates II and III show the results of the baiting from June 21 to September 3; first counts were made two days prior to actual baiting. The interval was divided into seven day periods and average number of flies per square yard was computed for that period; the range in number of living flies for that period is also shown on that same line. The term "ounces bait per 1000 square feet for period" refers to the rate of application per 1000 square feet of floor surface.

EXPLANATION OF PLATE II

The data on Plate II show the results of the baiting tests as they took place from June 19 to September 3; the period is divided into seven day periods. Shown also are the stations at which baiting was done, the bait used, the average flies per square yard, the number of treatments, the amount of bait per 1000 square feet of floor surface for each period and station.

PLATE II

STA.	7 DAYS BEGINNING	6/19 AV.	RANGE	6/26 AV.	RANGE	7/3 AV.	RANGE	7/10 AV.	RANGE	7/17 AV.	RANGE	7/24 AV.	RANGE	7/31 AV.	RANGE	8/6 AV.	RANGE	8/13 AV.	RANGE	8/20 AV.	RANGE	8/28 AV.	RANGE	9/3 AV.	RANGE
1A	MALATHION FLIES/SQ. YD.	24	13-40	20	9-30	15	7-44	19	10-21	19	12-20	14	7-23	8	7-9	11	9-14	11	10-12	9	7-10	15	10-16	8	
	OZ. BAIT FOR PERIOD	15		15		32		15		16		16		8		20		20		14		33		8	
	NO. OF TREATMENTS	5		5		5		3		3		4		2		2		3		2		4		1	
	OZ. BAIT/1000 SQ.FT. FOR PERIOD	10.8		10.8		22.9		10.8		11.4		11.4		5.8		14.4		14.4		10.0		23.0		5.8	
1B	MALATHION FLIES/SQ. YD.	24	16-25	40	25-56	23	12-35	23	18-40	20	6-35	11	8-13	15	14-16	12	11-14	12	8-15	10	9-12	11	9-13	25	
	OZ. BAIT FOR PERIOD	13		15		32		15		16		16		8		20		20		14		33		8	
	NO. OF TREATMENTS	5		5		5		3		3		4		2		2		3		2		4		1	
	OZ. BAIT/1000 SQ.FT. FOR PERIOD	9.4		10.8		22.9		10.8		10.8		11.4		5.8		14.4		14.4		10.0		23.0		5.8	
12	MALATHION (SPRAY) FLIES/SQ. YD.	61	6-165	34	16-65	51	26-90	14	2-38	30	1-32	23	1-40	30	3-40	14	4-25	50	45-75	18	0-30	10	——	—	—
	OZ. BAIT FOR PERIOD	13		17		21		SPRAYED						SPRAYED				SPRAYED		SPRAYED		EMPTY		—	
	NO. OF TREATMENTS	5		4		5		7/13						7/26				8/16		8/20				—	—
	OZ. BAIT/1000 SQ.FT. FOR PERIOD	14.7		18.7		22.9		10 GALS.						10 GALS.				3 GALS.		10 GALS.					
12 B	MALATHION FLIES/SQ. YD.	11	5-20	11	10-12	8	4-8	8	7-11	8	6-11	12	11-13	11	11-12	60	——	35	5-75	7	7	5	4-5	—	—
	OZ. BAIT FOR PERIOD	12		18		21		11		11		12		12		8		5		15		22		—	
	NO. OF TREATMENTS	5		4		5		3		3		4		2		2		3		3		4		—	
	OZ. BAIT/100 SQ.FT. FOR PERIOD	6.0		8.0		10.5		5.5		6.0		6.0		6.0		4.0		3.0		7.5		7.5		—	—
12 A	MALATHION FLIES/SQ. YD.	14	8-20	13	11-18	8	7-9	17	12-24	12	12-13	19	16-21	17	14-20	11	9-12	12	9-12	7	5-10	10	4-18	—	—
	OZ. BAIT FOR PERIOD	12		16		21		11		11		12		10		8		5		15		22		—	
	NO OF TREATMENTS	5		4		5		3		3		4		2		2		3		3		4		—	
	OZ. BAIT/1000 SQ FT. FOR PERIOD	8.0		11.8		14.0		7.3		7.3		7.3		8.6		5.3		3.3		10.0		14.5		—	—
12 C	MALATHION FLIES/SQ. YD.	6	4-10	7	5-9	6	4-8	7	4-10	4	4-5	5	4-7	5	4-7	11	10-12	5	3-8	8	4-8	4	3-5	—	—
	OZ. BAIT FOR PERIOD	12		16		21		11		11		12		12		8		5		15		12		—	
	NO. OF TREATMENTS	5		4		5		3		3		4		2		2		3		3		4		—	
	OZ. BAIT/1000 SQ.FT. FOR PERIOD	12.0		16.0		11.0		11.0		11.0		12.0		12.0		8.0		5.0		15.0		12.0		—	
4	DIAZINON FLIES/SQ. YD.	55	27-90	31	18-40	38	35-53	52	51-62	65	60-68	64	34-118	50	29-70	40	36-45	70	40-125	10		16		20	
	OZ. BAIT FOR PERIOD	21		21		31		28		40		44		42		62		32		9		32		16	
	NO. OF TREATMENTS	5		4		5		3		3		2		2		2		1		1		4		1	
	OZ. BAIT/1000 SQ. YD. FOR PERIOD	10.0		10.0		15.5		14.0		20.0		22.0		21.0		31.0		16.0		4.5		16.0		8.0	
9	DIAZINON VARNISH FLIES/SQ YD. BAITED	6/29		31	9-75	11	6-21	10	8-15	12	8-16 7/16	10	7-16	17	18-18	6	6-7	9	5-18	10	3-15	9	4-19	25	—

EXPLANATION OF PLATE III

The data on Plate III show the results of the baiting tests as they took place from June 19 to September 3; the period is divided into seven day periods. Shown also are the stations at which baiting was done, the bait used, the average flies per square yard, the number of treatments, the amount of bait per 1000 square feet of floor surface for each period and station.

PLATE III

	7 DAYS BEGINNING	8/19	8/26	7/3	7/10	7/17	7/24	7/31	8/16	8/13	8/20	8/28	9/3
		AV. RANGE	AV. RANGE	AV. RANGE	AV. RANGE	AV. RANGE	AV. RANGE	AV. RANGE	AV. RANGE	AV. RANGE	AV. RANGE	AV. RANGE	AV. RANGE
7	BAYER L13/59 FLIES/SQ. YD. OZ. BAIT FOR PERIOD NO. OF TREATMENTS OZ. BAIT/1000 SQ.FT. FOR PERIOD	28 5-55 32 5 5.6	9 7-15 25 4 4.7	8 5-9 27 4 5.0	11 10-13 11 2 2.0	6 3-9 11 3 2.0	9 5-14 21 4 3.9	6 3-9 11 2 2.0	8 5-7 6 2 1.1	7 5-10 30 3 5.4	4 4 12 2 2.2	9 7-11 48 3	14 — 18 1
13	BAYER L13/59 FLIES/SQ. YD. OZ. BAIT FOR PERIOD NO. OF TREATMENTS OZ. BAIT/1000SQ.FT FOR PERIOD	18 5-45 22 5 4.4	12 8-15 24 4 4.4	8 7-9 12 4 2.4	5 2-7 16 2 3.0	8 2-16 9 3 1.8	9 6-14 18 4 3.6	6 4-7 8 2 1.6	7 6-8 6 2 1.6	10 8-12 24 3 4.8	8 4-13 25 2 5.0	6 — — 48 2 9.0	10 — 16 1 3.0
14	BAYER L13/59 FLIES/SQ.YD. OZ. BAIT FOR PERIOD NO.OF TREATMENTS OZ. BAIT/1000 SQ.FT. FOR PERIOD	17 5-25 20 5 6.6	8 2-16 13 4 4.3	4 2-5 22 4 7.1	4 2-5 15 2 5.0	3 2-3 7 3 2.3	3 2-4 17 4 5.6	2 1-3 8 2 2.7	2 2-2 9 2 3.0	2 2-2 18 3 5.3	11 2-30 31 2 10.0	11 6-15 32 2 10.2	9 — 12 1 5.0
10	CHLOROTHION FLIES/SQ.YD. OZ.BAIT FOR PERIOD NO.OF TREATMENTS OZ. BAIT/1000SQ.FT. FOR PERIOD	15 10-21 24 2 9.6	28 21-31 55 6 22.0	29 40-45 36 5 14.4	17 14-25 23 3 9.5	26 12-31 22 3 9.2	28 27-30 100 4 40.0	12 10-14 32 1 14.0	24 † 32 2 14.0	58 15-90 56 3 22.2	35 10-50 48 3 18.4	20 10-40 52 3 20.4	8 — 10 1 4.0
15	CHLOROTHION FLIES/SQ.YD. OZ. BAIT FOR PERIOD NO OF TREATMENTS OZ. BAIT /1000 SQ.FT. FOR PERIOD	22 15-30 16 2 11.4	43 20-60 48 6 38.0	25 18-39 33 5 23.0	25 17-29 24 3 19.0	19 15-25† 18 3 12.0	9 8-9 24 4 19.0	15 15-16 17 2 11.9	13 11-14 13 2 9.8	10 8-15 24 2 19.0	10 5-15 24 4 19.0	22 12-24 22 3 17.	8 — 12 1 13.6
5	FLIES/SQ. YD. CONTROL	32 12-50	22 9-40	23 12-32	26 13-39	16 15-19	25 15-36	20 14-26	30 28-35	44 28-60	SPRAYED		
5A	FLIES/SQ. YD. CONTROL	23 20-35	96 50-200	63 25-100	44 35-45	23 12-32	24 19-32	20 19-21					
8	FLIES/SQ. YD. CONTROL	15 10-20	11 9-20	14 7-28	21 19-23	22 19-25	12 10-13	11 11	30 10-13	15 11-17	16 16-20	13 11-16	15 —
3	FLIES/SQ. YD. CONTROL							20 18-22	21 20-23	18 18	24 20-28	27 23-30	30 —

† DIAZINON

† MALATHION

This method was selected since buildings varied in size and the amount of floor space available for baiting varied also. In none of the buildings could more than half the actual floor space be baited. The footnote figures indicate that in Stations 10 and 15 there were substitutions made as the chlorthion bait was expended.

The northeast wing (Station 1A), the southeast wing (Station 1B), and the southwest wing (Station 15) were baited the entire season from June 21 to September 3. The main part of the dairy barn, holding stanchions for more than 100 cows, was not baited because the floors and walls were hosed with water twice daily. In the center aisle spilled silage served as a fly attractant; no baiting could be done here because the silage was cleaned up and re-used for feed. In stations 1A and 1B malathion was used, resulting in an average of 13 flies per square yard during the period July 10 to September 3 which was the period after populations had been substantially reduced by daily applications. In Station 15, chlorthion was used until July 17, but fly populations were not being effectively reduced as indicated by average counts of 22, 43, 25, and 25. A switch to malathion resulted in an average count of 13; this average figure is compared to an average count of 33 among the controls.

In the buildings at the poultry plant (Stations 12A, 12B, and 12C), malathion dry bait was used for the entire season. The control problem was not in the buildings themselves because

the buildings were kept clean and dry. Once when rain leaked into one building (12B-8/6), flies bred rapidly to a peak of 60 flies per square yard in the wet manure. As soon as it was removed the counts lowered again. The average fly counts from July 10 to September 3 were 11 flies per square yard in the buildings at the poultry plant.

In the beginning, the turkey platforms (Station 12) presented somewhat of a problem. The accumulation of manure under the roosts was very attractive to adult flies and they congregated in great numbers under these platforms. This wet manure was also serving as a larval medium and was producing large numbers of flies. It was difficult to apply insecticides to this breeding medium because anything thrown or any apparatus extended under the platform would send the turkeys into a panic. It had been reported that several turkeys had been killed in previous years as a result of being panicked while fly control was being done. At first an attempt was made to bait the roosts by placing large boards around the perimeter of the platforms and sprinkling the bait on them. The slightest breeze blew the bait off the boards onto the ground where it was unavailable to flies. Spray bait consisting of ten gallons of water, ten pounds of sugar, and eight ounces of fifty-seven per cent oil emulsifiable malathion was then applied to the manure and the area surrounding the platforms. This spray bait remained at an effective level for ten to fifteen days. After that period it was covered by

manure or washed away by rains. Strangely, the spraying operation did not disturb the turkeys. When the motor on the sprayer started they seemed to concentrate on the noise of the exhaust and apparently did not notice the spray stream as it was played around under the roosts.

At the hogshed (Station 9), dry baiting was not carried on although the floor was dry and clean and dry baiting would have worked well. The herdsman stated that pigs were handled and weighed several times a week in the alleyways. Since pigs might have gleaned a substantial amount of poisoned bait from the floor, it was decided to use a hard or varnish bait out of reach of the hogs. Four or five pounds of diazinon dry bait were mixed with water and spread on the walls and studdings high enough up on the walls to prevent a pig from reaching it. Several sacks were also rolled up and dipped in the mixture and hung from the ceiling. The varnish was replenished only once during the summer. Fly counts averaged 13 per square yard during the period July 10 to September 3.

The Kansas Artificial Breeders' Service Unit (Station 13), was somewhat reluctant to try the baiting at first. They were concerned about the material drifting about the premises and contaminating the bull semen and ruining the viability. In previous years, when spraying was done to control flies, it had to be done at least twenty-four hours previous to the next collection day. This had to be done to give the spray drift ample time to dry and settle. While spraying was done each

animal had to be outside and left out until the spray had dried. The workers were willing to give the baiting a try. After about a month had passed and the baiting program was well established, the manager was questioned as to whether the baiting was affecting the quality of the bull semen. He stated that as far as could be determined there was no change in the storing qualities and viability since the program had started. This type of fly control is well adapted to such an organization as this because it did not upset their schedule, it did not necessitate extra handling of dangerous animals, nor did it affect the quality of the bull semen. Fly counts for the K.A.B.S.U. barns averaged 8 per square yard during the period July 10 to September 3.

At the veterinary experimental hospital (Station 7), baiting also worked well. Fly counts averaged eight per square yard during the period July 10 to September 3. Here there were large banks of cages containing dogs, cats, rabbits, and guinea pigs as well as pens of cattle and hogs. In previous years, when residual spraying was done, it was necessary to wash each food and watering cup when the job was finished. Since bait was placed only in halls and alleys it was not necessary to wash every cup before the next feeding.

Another interesting observation was noted in the K.A.B.S.U. bull barn and the sheep barn (Station 14). As newer barns are built, the concrete floors are no longer trowelled smooth as the cement sets. Instead a stiff broom is drawn over the setting cement which gives an even but rough textured surface. This

type of floor prevents accidental falling of workers and animals even though the floor is wet. As bait was scattered over these floors it worked down into the depressions in the surface of the cement either by being walked upon or as the floor was swept. This residue remained effective in spite of the fact that the floor was swept. In one instance it was noted that in one barn the floor had not been baited for three days and yet the flies were dying in large numbers in spite of the fact that the floor had been swept at least seven times since it was last baited. In the sheep barn this residual action did not last as long as in the bull barn, but it did last well from one baiting to the next. In the sheep barn averaged five per square yard during the period July 10 to September 3.

The experimental hogshed (Station 4) was a difficult building in which to obtain any degree of control. Hogs in this shed were on controlled nutrition experiments, in individual pens, with individual feeders and waterers. When the weather became hot, pigs would paw water from the waterer onto the floor and lie in it to cool themselves. Soon the entire floor was covered with water and the bait was dissolved. The wet and fermenting manure was more attractive to flies in the vicinity of the hogshed than it would have been if the floor had been dry. Furthermore, a large barn designated as a check (Station 5) was located immediately across the fence, which produced a large number of flies. These flies were attracted to the hogshed by its stronger odor. Diazinon was used in the

experimental hogshed resulting in an average count of 42 flies per square yard for the period July 10 to September 3. In spite of the large number of flies that baiting killed (Figs. 3 and 4), a substantial number of living flies remained. The show barn (Station 15), when diazinon bait was substituted for chlorthion, resulted in counts which dropped quite steadily even though diazinon was not used on an everyday basis, as evidenced by average counts 13 per square yard from July 10 to September 3. It is apparent that diazinon would have been much more effective had it been used where populations were not so high as occurred in Station 4.

In the buildings which were used as controls (Stations 5, 5A, 8, and 3) the average count for the period July 10 to September 3 was 30 flies per square yard. At Stations 5 and 5A there cattle on feeding experiment; as can be seen from Plate III, the fly populations were the heaviest at these two stations. The other buildings had only one or two animals in them most of the time, consequently the fly counts remained quite low for most of the season. Sanitation was not good but the manure had a chance to dry out so it was not very attractive to flies. The sheds at Stations 5 and 5A were the heaviest populated of the untreated controls.

Table 1 presents combined data, comparing the insecticides from July 10 to September 3, which was the period after initial repeated baitings had reduced the fly population substantially. Bayer L13/59 produced the best results at the lowest application

Table 1 Average numbers and range of houseflies (baiting on alternate days from July 10 to September 3), after fly populations had been initially reduced by daily applications from June 19 to July 3.

TOXICANT	OZ./1000 SQ.FT.[1]	AV./SQ.YD.	RANGE/SQ.YD.	% CONTROL
BAYER L13/59	4.4	7	1-30	77
MALATHION	10.5	13	4-60	57
DIAZINON	18.0	42[2], 13	10-125[2], 5-24	57
CHLORTHION	17.0	23	12-45	23
CONTROLS		30	11-60	

1 Based upon a 7 day period.

2 Exceptionally high natural population to be controlled.

rate. Diazinon and malathion were about equally effective at the rates used. Chlorthion was the least effective.

SUMMARY AND CONCLUSIONS

Baiting for housefly control was discontinued upon the advent of DDT, but was again initiated when resistance to this insecticide by houseflies became evident. This study consisted of the use of four organic phosphorus compounds formulated at a rate of one per cent of the toxicant in granulated sugar to make a dry bait. Baiting was initiated in a number of barns and other animal shelters on the Kansas State College campus. Initial baiting was commenced on June 21 and was applied almost daily from that date until July 5. This was the period necessary to bring the fly population down to a point where daily applications were no longer necessary. The frequency of application was then changed to two to four times a week. No pens were baited unless they were unoccupied and would continue so for some time.

Bayer L13/59 gave the better results. It not only resulted in lower population counts (7 flies per square yard), but took less material per floor area (4.4 oz. per 1000 square feet for seven days). On roughened floor Bayer L13/59 gave good control for as long as three days although the floors had been swept as often as twice daily. The buildings in which Bayer L13/59

was used were well isolated and this may have contributed somewhat to their success. However, sanitation was no different than in other buildings.

Malathion resulted in fairly low counts (13 per square yard) by taking slightly more bait (10.5 oz. per 1000 square feet). Dry bait used out of doors was not successful and required the use of spray bait. Spray bait gave good results with the length of effectiveness lasting about fifteen days.

When diazinon was used under ordinary population conditions, the result was 13 flies per square yard, taking 18.0 oz. bait per 1000 square feet per seven days. In the hog shed, where populations were exceedingly high, it was not effective; a large area nearby, used as a control, was producing large numbers of flies which were attracted to the odor of the hog-shed. Leaking waterers and extremely wet floors dissolved the bait making it unavailable to flies.

Chlorthion resulted in counts of 23 living flies per square yard and was soon discontinued. It is believed that it might have worked better if the toxic ingredient had been increased.

Dry baiting as a method of controlling houseflies was effective; however, more efficient control would probably have been attained by all baits had they been used more extensively. Dry baiting is simple and inexpensive; it can be done with a minimum of investment in equipment. It is well adapted to be used in most farm buildings where there is sufficient space

for it to be scattered. Dry baiting also makes unnecessary the use of cumbersome pans and containers.

While sugar baits are effective in killing large numbers of houseflies, they do not present the complete answer to housefly control. Dry sugar baits cannot be expected to provide adequate control when sanitation practices are slighted.

EXPLANATION OF PLATE IV

Harrison McGregor scattering dry bait on the floor of a barn. Note the dead flies on the floor from the previous baiting. In this building Bayer L13/59 was used.

PLATE IV

PL TE V

Fig. 1 Dead flies scattered on the floor in a doorway. Result of one night's baiting with Bayer L13/59.

Fig. 2 Piles of dead flies made by eddying winds in one of the hogsheds where dry baiting was done using diazinon dry bait.

PLATE V

Fig. 1

Fig. 2

PLATE VI

Fig. 1 Piles of dead flies in the corner of one building. This pile was about an inch deep. Diazinon dry bait was used in this shed.

Fig. 2 The pile of flies in this picture represents the results of baiting in three buildings for three days (Stations 4, 7 and 15).

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ACKNOWLEDGMENTS

The writer wishes to express his sincere appreciation to Dr. Herbert C. Knutson, Head of the Department of Entomology, for suggesting the work, for guidance, and for constructive criticism during the course of the investigations.

Many thanks are due Dr. R. C. Bushland, Dr. H. M. Brundrett, and Mr. Charles C. Smith, of the Entomological Research Branch Laboratories of the United States Department of Agriculture at Kerrville, Texas who were helpful in initiating the tests.

Thanks are also extended Harrison E. McGregor, a student at Kansas State College, for his assistance in the field work.

HOUSEFLY CONTROL WITH DRY BAITS FORMULATED FROM ORGANIC PHOSPHORUS INSECTICIDES AND SUGAR

by

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AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Entomology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1955

Fly baits using milk and formalin or arsenic were in common use prior to World War II. When DDT became available, residual sprays replaced baits; but baiting was again initiated when resistance to chlorinated insecticides became evident. Organic phosphorus insecticides are effective in controlling houseflies but are too toxic to mammals to be used as residual sprays in many instances. Low concentrations of these insecticides with an attractant can be used safely and effectively.

Baiting tests were conducted as a part of the campus fly control program during the summer of 1954. The buildings in which tests were conducted were animal barns located on the Kansas State College campus. These buildings were divided into fifteen baiting stations and a specific formulation assigned to each station.

All the baits were formulated at a rate of one per cent of the toxic ingredient in an attractant which was granulated sugar. The toxic ingredients were: malathion, diazinon, chlorthion, and Bayer L13/59. The baits were applied to floors and other horizontal surfaces in the test buildings out of reach of animals occupying these buildings. Shaker jars for the bait were devised from pint fruit jars with holes pierced in the lids. When baiting was initiated on June 21 applications were made nearly every day; by July 5 the fly populations diminished to a point where applications were reduced to two to four times a week.

Where it was not feasible to use dry bait, varnish or hard bait was made by dissolving dry bait in water and

spreading it on walls and studdings. Spray bait was used for manure treatment because dry bait was blown away or otherwise destroyed.

Estimation of the density of housefly populations was made by counting the flies in an estimated square yard of floor or wall surface in areas of maximum density. Counts of dead flies were not made because the better measure of control efficiency is based upon the numbers of living flies in a treated area.

Bayer L13/59 gave the better results of the materials tested. It produced a seasonal average of seven flies per square yard compared to 30 in the controls, using 4.4 ounces of bait per 1000 square feet of floor surface for a seven day period. On rough concrete floors Bayer L13/59 gave control for as long as three days although the floors were swept twice daily.

Malathion dry baits gave average fly counts of 13 flies per square yard compared to 30 in the controls, using 10.5 ounces of bait per 1000 square feet of floor surface for a seven day period. Malathion dry bait used out-of-doors was not successful. When spray bait was substituted in its place, it gave effective control for about fifteen days.

Diazinon was not particularly effective in one station because fly populations were exceedingly high. Furthermore, extremely wet floors dissolved the bait making it unavailable to flies. Where diazinon was used under populations conditions

similar to the other stations, the result was an average of 13 flies per square yard compared to 30 per square yard in the controls, using 18 ounces of bait per 1000 square feet of floor surface per seven day period. Results were similar to those obtained with malathion dry bait.

One per cent chlorthion dry bait was not effective. Chlorthion achieved an average of 23 flies per square yard compared to 30 per square yard in the controls, using 17 ounces of dry bait per 1000 square feet of floor surface per seven day period. Chlorthion was not used in the tests after July 30.

The dry baiting technique was found to be well adapted for use in farm buildings as long as the floors were fairly dry and clean. Where dry baiting was not possible, varnish baits or spray baits were effective but required the use of special equipment. Dry baiting was found to be effective where sanitation was practiced, but it was not found to be a substitute for sanitation in fly control.